New X-Band Microwave Equipment at the DSN 64-Meter Stations

R. Hartop
Radio Frequency and Microwave Subsystems Section

In order to improve the performance and capabilities of the DSN 64-m antennas at X-band, extensive modifications to the XRO cone assemblies are in process. The changes include a new feed assembly with a dual hybrid mode horn and orthogonal mode junction, dual traveling wave masers, and a new receiver mode selector.

I. Introduction

The X-band cone assembly (Ref. 1) on the 64-meter antennas originally provided the capability for RCP reception only, with one traveling-wave maser (TWM). The feed was later changed to a Mod II version (Ref. 2) that provided remotely selectable RCP or LCP.

In order to provide increased performance and additional capabilities, especially for the Voyager mission, the XRO cone has undergone a complete redesign. It is planned to reconfigure the three DSN cones in the field; this is the first time such an extensive change to a feed cone has been attempted in place.

After removal of some 90 percent of existing equipment within the cone, the following major changes will be implemented:

(1) A new feed assembly, the Mod III XRO feed.

(2) Dual X-band traveling wave masers.

(3) New monitor receiver.

(4) New TWM support racks.

(5) New output waveguide runs.

(6) New output switching configuration for the monitor receiver.

(7) New receiver mode selector.

To further complicate the changes, the two overseas stations will be implemented with the new Mod III feed assembly on a different schedule from DSS 14. Thus it was necessary to design two new XRO cone configurations: (1) the Mod II version for overseas serves as an interim configuration until items (1) and (7) above are implemented; and (2) the Mod III version for DSS 14 and, later, DSS 43 and DSS 63. Because of the differences in physical size and output configuration of the Mod II and Mod III feeds, this required extensive differences in such details as the maser support stands, maser output waveguides, switch control subsystem, and many support brackets and hardware.

II. The Mod III XRO Feed Assembly

The new feed assembly (Fig. 1) provides the following major changes:

(1) A dual hybrid mode feed horn (Ref. 3) for more efficient subreflector illumination.

(2) An orthogonal mode junction to permit the simultaneous reception of RCP and LCP.

As discussed in Ref. 3, it is expected that the new feed horn will increase the antenna gain approximately 0.29 dB.

III. Dual Traveling Wave Masers

The primary purpose of implementing dual masers is to improve reliability during critical encounter periods by having a second maser cooled down and ready to be switched on line in seconds should the primary maser fail. The presence of two operating masers, however, also leads to increased radio science capability. Thus, with the orthogonal mode junction, it will be possible to receive two orthogonal polarizations simultaneously. Since the polarization selectability of the Mod II feed is retained in this new feed, it is possible to remotely select which polarization (RCP or LCP) is received by TWM 1, with TWM 2 receiving the opposite polarization at all times.

IV. Receiver Mode Selector

Because of this dual-channel feature, it was necessary to design a new receiver mode selector that provided two inputs (rather than a single input as before) and four receiver outputs, so configured that any receiver can independently connect to either maser output. Up to four additional receivers (for a total of eight) can also be connected to the mode selector panel, but with some restrictions on independent maser output selection.

V. Configuration Control Subsystem

Concurrently with the changes to the XRO cone assembly, a new configuration control subsystem is being implemented. This necessitated additional changes in the cone switch control junction box, cable package, and control panel.

VI. Maser Support Equipment and Output Waveguides

With the removal from the cone of the older configuration maser package and monitor receiver, it was necessary to relocate the output waveguide runs and design new brackets for the new maser packages and their support racks. This is the second installation of this equipment after the SXD cone assemblies for the 34-m antennas (Ref. 4), and some of the techniques generated in that project were adapted to the XRO cone redesign. A complicating factor in laying out the waveguide runs involves the requirements for four waveguide couplers. One coupler for each maser output supplies the monitor receiver with its signal through a waveguide switch to select TWM 1 or 2. An additional coupler for each maser output provides an injection point for calibration signals.

VII. Field Implementation

At the time of this reporting, DSS 14 has been implemented with the Mod III configurations, with only a few minor details remaining to complete the task. Test data are not yet available.

During October and November the overseas stations will be implemented with the Mod II XRO cone configurations (dual masers only). It is planned to upgrade these stations to the Mod III configuration during late 1979, in time for Saturn encounter.

References

1. Hartop, R., "X-Band Antenna Feed Cone Assembly," TR 32-1526, Vol. XIX, pp.173-175, Jet Propulsion Laboratory, Pasadena, Calif., Feb. 15, 1974.

2. Hartop, R., "Selectable Polarization at X-Band," PR 42-39, pp. 177-180, Jet Propulsion Laboratory, Pasadena, Calif., June 15, 1977.

3. Thomas, R., and Bathker, D., "A Dual Hybrid Mode Feedhorn for DSN Antenna Performance Enhancement," PR 42-22, pp. 101-108, Jet Propulsion Laboratory, Pasadena, Calif., Aug. 15, 1974.

4. Hartop, R., "Dual Frequency Feed Cone Assemblies for 34-Meter Antennas," PR 42-47, pp. 85-88, Jet Propulsion Laboratory, Pasadena, Calif., Oct. 15, 1978.

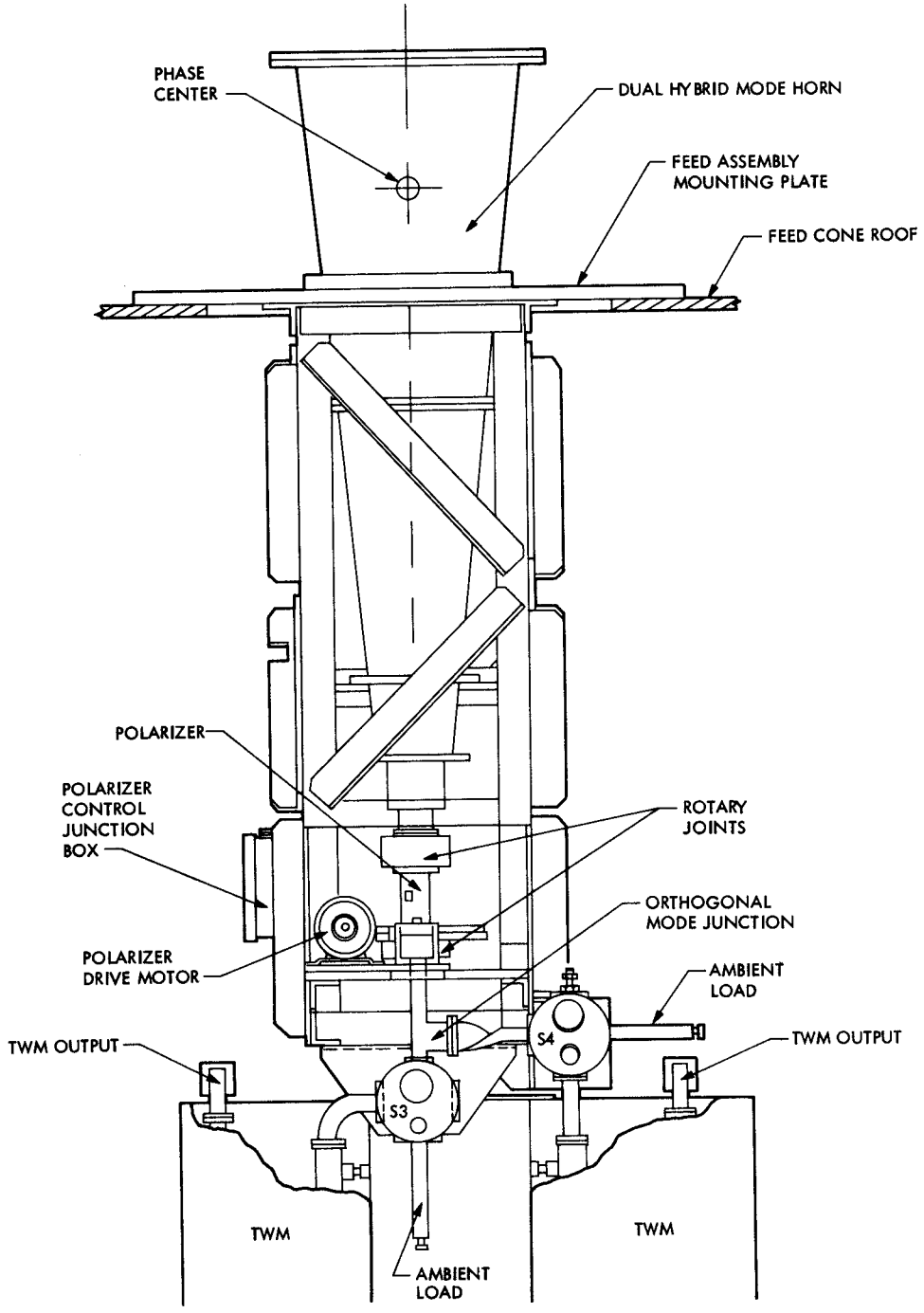

Fig. 1. The Mod III XRO feed assembly